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$\left\{ \frac{2np\Delta}{apm+bn-clp+cm}, \frac{2n\Delta}{apm+bn-clp+cm}, -\frac{2\Delta(lp-m)}{apm+bn-clp+cm} \right\}$  are the co-ordinates of  $C$ ;

$\left\{ 0, \frac{2\Delta(qn-1)}{b(qn-1)+cmq}, \frac{2\Delta mq}{b(qn-1)+cmq} \right\}$  are the coordinates of  $B$ ;

$\left\{ \frac{2\Delta(qn+1)}{a(qn+1)-qcl}, 0, -\frac{2\Delta ql}{a(qn+1)-qcl} \right\}$  are the coordinates of  $D$ .

${}^a mq + {}^\beta pmq - {}^\gamma p(qn-1) = 0$ , is the line through  $AB$ ;

${}^a nql - {}^\beta (qmn + m - lp) + {}^\gamma n(qn+1) = 0$ , is the line through  $CD$ .

Comparing, we get  $q=0$  or  $q=-(1/n)$ ,  $p=m/l$  or  $p=0$ . There are no positive values for  $q$  when  $p$  is positive. When  $p$  is positive,  $q=0$ , etc.

Whatever relations we establish we cannot find  $p$  and  $q$  both real or both positive.

## CALCULUS.

286. Proposed by R. D. CARMICHAEL, Princeton University.

Solve the differential equation

$$\begin{aligned} & [a_0x^3 + a_1x^2y + a_2xy^2 + (a_0 - a_1 + a_2)y^3 \\ & \quad + a_3x^2 + a_4xy + a_5y^2 + a_6x + a_7y + a_8]dx \\ & + [a_0y^3 + a_1xy^2 + a_2x^2y + (a_0 - a_1 + a_2)x^3 \\ & \quad + a_3y^2 + a_4xy + a_5x^2 + a_6y + a_7x + a_8]dy = 0. \end{aligned}$$

No solution of this problem has been received.

287. Proposed by C. N. SCHMALL, 604 East 5th Street, New York City.

An object  $P$ , being placed beyond the principal focus  $F$  of a convex lense, determine its position when its distance  $PQ$ , from its image  $Q$ , is a minimum.

Solution by G. B. M. ZERR, A. M., Ph. D., Philadelphia, Pa.

Let  $u$ =distance of object from lense,  $v$ =distance of image from lense,  $t$ =thickness of lense, and  $r, s$ =the radii of the first and second surface.

Then  $\frac{1}{\frac{1}{v} + \frac{\mu-1}{s}} + \frac{1}{\frac{1}{u} - \frac{\mu-1}{r}} = \frac{t}{\mu}$ , where  $\mu$ =index of refraction, or

$$\mu \left( \frac{1}{u} + \frac{1}{v} \right) = \left( \frac{1}{r} - \frac{1}{s} \right) \mu (\mu - 1) + t \left( \frac{1}{v} + \frac{\mu-1}{s} \right) \left( \frac{1}{u} - \frac{\mu-1}{r} \right) \dots (1).$$